ANNUAL
FALL 2019

Institute for Pure and Applied Mathematics
a National Science Foundation Math Institute
at the University of California, Los Angeles

NEWSLETTER

SPEARHEADING LATMATH CONFERENCES TO PROMOTE ROLE MODELS FOR YOUNG LATINX

As an aspiring mathematical scientist growing up in Colombia, Tatiana Toro had plenty of role models who looked like her. "I was unaware of the color of my skin until I came to the United States for graduate school at age 23," Toro says, laughing. "But once I was here, I learned that it is a very different experience for a Latina born in the United States who has an interest in mathematics."

Toro excelled in her chosen field early on, competing for her native country in the International Mathematical Olympiad in 1981, when she was 17. After earning her bachelor's degree in Colombia, she enrolled at Stanford University, graduating with her PhD in 1992. Four years later she joined the University of Washington faculty, where she is currently the Craig McKibben & Sarah Merner Professor in Mathematics. While Toro started her career focusing on geometric measure theory, today she considers her research to lie at the interface of geometric measure theory, partial differential equations, and harmonic analysis, with a focus on the properties of interfaces arising in "noisy" minimization problems.

Along the way Toro has received considerable recognition and support for her work, including an Alfred P. Sloan Doctoral Dissertation Fellowship, an NSF Mathematical Sciences Postdoctoral Research Fellowship, two Simons Foundation Fellowships and a Guggenheim Foundation Fellowship. She was elected as a fellow of the American Mathematical Society in 2017, and was inducted the same year as a member of the Academia Colombiana de Ciencias Exactas, Fisicas y Naturales.

But even as she was experiencing so much success, Toro became concerned that many young Latinx weren't getting the encouragement they needed to pursue careers in the mathematical sciences.

Tatiana Toro
University of Washington

(continued on page 7)

INDUSTRIAL SHORT COURSE SERIES INAUGURATED


Xavier Bresson
NTU

In an era of rapid technological progress, artificial intelligence (AI) can be found integrated in our everyday lives and at the forefront of industrial applications. IPAM hosted a second Industrial Short Course on Deep Learning and the Latest AI Algorithms on May 16-17, 2019. A cohort of industry professionals from all career levels spent two days exploring and coding the latest deep learning algorithms, integrating applications of deep learning into their projects, and upgrading their AI skillset. Participants were taught by leading deep learning researcher Xavier Bresson from Nanyang Technological University (NTU). With two successful courses in the last year, IPAM Deputy Director Christian Ratsch is looking forward to what's next: "The goal of this program is to strengthen our ties to industrial partners and to advertise and promote the usefulness of mathematics in industry. We have received encouraging feedback and plan to expand this program to include other topics in the future." Check back on IPAM's website for information on our 2020 course offerings. With a class limit of 20 participants, early registration is highly encouraged. ■

FEATURES

HIGHLIGHTS

INFORMATION

NOTE FROM DIRECTOR DIMA SHLYAKHTENKO

This has been an incredibly successful and busy year for IPAM, a testimony to its well-deserved reputation as the place for mathematical innovation. Our Fall 2018 Big Data Meets Large-Scale Computing long program explored the latest directions of and mathematical techniques in scientific computing, including new trends such as AI, in-situ data processing, and forward-looking computer architectures. The Spring 2019 Geometry and Learning in 3D and Beyond long program explored the latest techniques in machine learning for three-dimensional and higher-dimensional data.

In addition to these programs, we offered seven scientific workshops on topics ranging from Hilbert's 13th problem to Autonomous Vehicles, to Materials for Quantum Computing, to Gravitational Waves. Two of these workshops, focusing on Mathematical Biology and on Public Policy, were specifically designed to address the issue of under-representation of women in mathematics.

One of the highlights of our trendsetting Research in Industrial Projects for Students (RIPS) program has been its expansion to a new site at the Institute for Mathematical Sciences at the National University of Singapore. This undergraduate offering complements our existing RIPS program at UCLA, as well as two graduate RIPS programs in Sendai, Japan and Berlin, Germany.

Last fall, IPAM inaugurated its Industry Short Course program, a new activity aimed at strengthening our industry partnerships, with a second course offered in the spring. Stay tuned for more exciting offerings from this program!

I would also like to express my deepest gratitude to IPAM's many sponsors for their generous contributions to our Institute. Thanks to a repeat $100K gift from AMD and other contributions by our donors, IPAM's Director's Endowment Fund has now surpassed the $500K mark. Proceeds from this endowment will allow IPAM to pursue potential high-reward activities that would not otherwise be possible.

Last, but not least, I want to share with you some staff updates: Assistant Director Stacey Beggs stepped down last winter to pursue another opportunity on the UCLA campus. I would like to thank Stacey for her 13 years of extraordinary service at IPAM, and wish her all the best in her new endeavors. And I would like to welcome back to IPAM our new Assistant Director Tammy Wong, who previously served on our program coordinator staff. Tammy brings to IPAM her management experience with large NSF-funded programs at UCLA. I am also pleased to announce that Stacy Orozco has accepted a new role at IPAM as Senior Program Manager with a portfolio of responsibilities that include IPAM's social media and outreach activities. ■

Dima Shlyakhtenko
IPAM Director

HARNESSING THE POWER OF MACHINE LEARNING AT IPAM

Frank Noé
Freie Universität Berlin

Frank Noé's affinity for IPAM comes as no surprise. IPAM brings wide-ranging mathematical techniques to bear on some of the biggest scientific challenges of the day through programs and workshops that join experts from disciplines that don't typically interact. In many ways, Noé embodies that mission.

Noé is the rare interdisciplinary scientist, working at the interface of machine learning, physics and chemistry. "I am someone who integrates knowledge from different disciplines, but of course that means in some sense I am less specialized on those disciplines than people who stay within one field," Noé says. "IPAM is one of the only places where I can interact with leading experts in quantum mechanics and in machine learning, for example, along with physicists and chemists. And hopefully, I can contribute by reaching across these disciplines to help people connect the dots."

After earning a BSc in electrical engineering in Stuttgart, Germany, Noé worked in an artificial intelligence startup company in Frankfurt. He then moved to Cork, Ireland, where he obtained his MSc in computer science before returning to Germany to complete a PhD in biophysics at the University of Heidelberg. Since 2007 he has been on the faculty at Freie Universität Berlin, where he holds an interdisciplinary chair in mathematics, physics and chemistry. He is also an adjunct professor in the Department of Chemistry at Rice University in Houston.

His research has focused on using machine learning and artificial intelligence in the natural sciences, particularly physics and chemistry. "It's only recently that machine learning has been found to be potentially useful for making scientific discoveries," Noé explains. "Our goal is, in a sense, to automate the knowledge distillation process from the data, especially for complex systems."

Noé's team has worked on molecular systems, including simulation and modeling of proteins as a path to better understand how certain processes in the body work, or what happens when they become dysfunctional, as in cancer and other diseases. To understand these physical building blocks of life, Noé and his team simulate them in computer models. "Machine learning is key for efficiently establishing parameters for simulating how the particles in these models move in time, as well as finding short-cuts for calculations that would otherwise be untractable," Noé explains.

(continued on next page)

IPAM a Key Venue for Interdisciplinary Scientist

(*continued from page 2*)

Over the course of the last decade, Noé has participated as a speaker and organizer in a number of IPAM workshops and long programs, and with each experience he has come away more convinced of the institute's value in facilitating the cross-disciplinary communication and collaboration needed to make strides on the types of challenging scientific issues he tackles. "Whether it's a long program or even one of the shorter workshops, IPAM gives you a lot of time to get to know the other participants, hold discussions, understand each other's work and, in some cases, think about working together on something new," he says. "Different disciplines have their own vocabulary even though there are common principles that connect them. At IPAM you can develop common understandings, and ultimately gain insights that can lead to new ways of addressing difficult problems."

As a scientist anchored in multiple disciplines, Noé enjoys assisting in the translation process. He is currently co-organizing Machine Learning for Physics and the Physics of Learning, a three-month IPAM program this fall that will bring together physicists, chemists and machine learning experts. "The gist of it is, let's try to use machine learning to learn something about physics, and let's use physics ideas to develop more powerful machine learning methods, especially for solving physics problems," Noé explains.

He notes that the vast majority of machine learning applications in physics and chemistry have used very simple methods, but there is much untapped potential. Powerful methods have been developed recently with the ability to extract information from complex data in ways that could dramatically advance the natural sciences. "But for that, physicists and chemists need to understand these methods better, which can come from more contact with the people who develop cutting-edge machine learning methods," Noé says. "At the same time, machine learners are always looking for interesting applications. At this program natural scientists will present their most exciting real-world problems, ask machine learners for their help in solving them and, hopefully, gain some scientific insight from these methods."

The machine learning field is now moving so quickly that it's hard to predict where it will be in even three years, and what that will mean for physics and chemistry, Noé observes. "But in most fields, things will move rapidly for a period, and then a big problem comes up that stops the progress until it can be solved," he adds. "It's difficult to predict what the next roadblock will be, but IPAM, where people from these different fields come together to share their expertise and work across traditional disciplinary boundaries, will continue to serve as an ideal venue for solving the problems that arise and moving the field forward." ■

IPAM FUELS GRAD STUDENT'S RESEARCH TRAJECTORY

I love my role as a graduate student in the Department of Geosciences at Baylor University, yet I often find myself in the awkward position of not really being a geologist, hydrologist, or geophysicist, but something "other." I do a lot of vigorous head nodding at talks about deep time and pedogenesis, but spend most of my time in my office thinking about how to make deep models generate accurate predictions. I am passionate about simulating physical systems, about tweaking algorithms and data transformations to unearth new truths about our environment. I work with techniques and mathematics that I did not know existed until a few years ago, and I have IPAM to thank for providing me with the incredible resources and opportunities that vastly broadened both my research and my life.

I first came to IPAM in 2018 for the New Deep Learning Techniques Workshop, and I left in awe. I was immediately impressed with the caliber and diversity of speakers and topics, as well as the careful crafting of an atmosphere that allowed renowned mathematicians and scientists to be very approachable. I sat next to another junior scientist who turned to me and said, "this is the best thing that has ever happened to me in my life!" and I completely agreed.

During a casual lunch, IPAM staff members told me what a great experience long programs are for junior scientists and encouraged me to apply. I applied for the upcoming long program Science at Extreme Scales: Where Big Data Meets Large-Scale Computing, and I was accepted. I think small moments like this highlight not just the excellence of IPAM, but how truly special the staff and faculty are.

My experience in the long program accelerated my research with readily available access to experts across fields who offered new insights and encouragement. In the workshops, I learned vocabulary related to topics I didn't know anything about, and gained the valuable skill of being comfortable with not necessarily knowing, but just absorbing and learning.

This fall, I am thrilled to return to IPAM as a participant in the fall long program Machine Learning for Physics and the Physics of Learning. It is a privilege to have the opportunity to attend IPAM for a third time, and I know I will gain new skills and intuition that will continue to enhance my research and collaborations as I begin my career.

While in residence, I will be honored to represent IPAM at the Modern Math Workshop at the annual SACNAS meeting as part of the NSF Mathematical Sciences Collaborative Diversity Initiative. Additionally, I will partner with the Department of Mathematics at California State University at Northridge to mentor undergraduate students in data analysis and to help pave a pathway to excellence for other young scientists.

It is extraordinarily rare to have everything you need, but if that can be found anywhere, it is at IPAM. ■

Katherine Breen
Baylor University

NEWS STORIES

YANN LECUN WINS A.M. TURING AWARD

The Association for Computing Machinery (ACM) has announced IPAM affiliate Yann LeCun (New York University and Facebook) as the recipient of the prestigious A.M. Turing Award along with colleagues Yoshua Bengio (University of Montreal) and Geoffrey Hinton (University of Toronto and Google). LeCun has been serving on IPAM's Science Advisory Board since 2008. He has also been an organizer, speaker, and participant for numerous long and short programs.

IPAM HOSTS COLLOBORATIVE WORKSHOP FOR WOMEN IN MATHEMATICAL BIOLOGY

This IPAM workshop was held from June 17-21, 2019. 45 members of the mathematical biosciences community explored various biological and medical questions using mathematical models to understand complex system dynamics. Led by expert leaders who supported junior and senior participants, seven teams spent the week making significant progress on an assigned research project. The week concluded with presentations of their findings and plans for continued collaboration, with the goal of each group publishing their results in a peer-reviewed volume. In addition to the projects, participants took part in a career panel and a networking session.

Participants of IPAM's Women in Mathematical Biology Workshop

EMILY CARTER RETURNS TO UCLA

Dr. Emily Carter will be returning to UCLA as Executive Vice Chancellor and Provost, effective September 1, 2019. In this role, Carter will be UCLA's chief academic officer, bringing leadership and a fresh perspective to campus-wide policy, planning, initiatives, and operations. IPAM is particularly thrilled with this appointment as Carter has been involved with IPAM since its inception. She helped establish IPAM, was an organizer and a speaker for many workshops through the years, as well as a keynote speaker in IPAM's 2013 public lecture, Quantum Mechanics and the Future of the Planet. Carter spent 16 years as a UCLA faculty member before heading to Princeton where she currently serves as dean of the School of Engineering and Applied Sciences, the Gerhard R. Andlinger Professor in Energy and the Environment, and a professor of mechanical and aerospace engineering and of applied and computational mathematics. Welcome back, Dr. Carter!

IPAM EXPANDS RIPS PROGRAM TO SINGAPORE

As part of IPAM's expansion of its Research in Industrial Projects for Students (RIPS) program, four U.S. undergraduate students traveled to Singapore last summer. There they worked in teams with students from the National University of Singapore (NUS) and ASEAN. For eight weeks the students immersed themselves in international research for local company sponsors: Google, Grab, Nvidia, and the Saw See Hock School of Public Health. Guided by academic mentors, the teams were tasked with solving real world industrial problems and gaining cross-cultural understanding. At the end of the program, the students presented their research and will have the opportunity to present at upcoming math conferences. Adding RIPS-Singapore to its roster, IPAM offers ample international research opportunities for students, including two graduate-level programs in Berlin and Sendai (G-RIPS).

WORKSHOP BRINGS WOMEN IN MATH AND PUBLIC POLICY

From January 22-25, 2019, 38 junior and senior women researchers in mathematics, science, engineering, and policy spent four days immersed in IPAM's Women in Math and Public Policy workshop to collaborate on topics in cybersecurity and climate change. Led by faculty researchers and RAND senior consultants, the participants worked in six small groups and had the opportunity to attend two public lectures by world-renowned, women researchers.

Group Photo of Women in Math and Public Policy Workshop

IPAM WELCOMES BACK TAMMY WONG AS ASSISTANT DIRECTOR

This past March, Tammy Wong rejoined the IPAM team as Assistant Director. No stranger to IPAM and its mission, Wong worked at IPAM in 2013 on the programs staff until 2017. IPAM staff and affiliates are glad for her return and are looking forward to her leadership in this role, as she brings recent experience gained from managing a sizeable National Science Foundation Research Traineeship grant at UCLA. IPAM bid farewell to former Assistant Director Stacey Beggs in February after 13 years of outstanding dedication and service. Beggs started her new position as Programs Director of UCLA's Department of Computational Medicine, and we wish her much success!

Tammy Wong
IPAM Assistant Director

DONOR RECOGNITION

CORPORATE GIVING

IPAM offers opportunities for corporations to participate in our scientific programs, propose topics for programs, and support activities that promote diversity in math and science. IPAM received gifts from the following companies in the past year:

- **The Aerospace Corporation**
- **Air Force Research Laboratory**
- **Alibaba**
- **Amazon**
- **AMD**
- **Google LA**
- **Gum Gum**
- **HRL**
- **Lawrence Livermore National Laboratory**

In addition to support from our main NSF grant, IPAM also received grant funding from the **Office of Naval Research, Simons Foundation, and NSF's Office of International Science and Engineering**. Special thanks to the **RAND Corporation** and **AWM** for their support of the Women in Mathematics and Public Policy Workshop and the Colloborative Workshop for Women in Mathematical Biology.

For more information on corporate giving, please visit our donor page at **www.ipam.ucla.edu/donate/corporate-giving.**

FUNDING PRIORITIES

Your financial support allows IPAM to fund opportunities that go beyond National Science Foundation support. You can donate online or by mail at any level. Donors giving $5,000 or more will be recognized on IPAM's donor wall. See **www.ipam.ucla.edu/donate** for details. For multi-year gifts or estate gifts contact Sharon Chang at **schang@support.ucla.edu**.

IPAM Director's Endowment Fund. Your gift will be part of an endowment that will grow over time and provide income to allow the Director to fund areas of need.

Child Care Fund. Help IPAM support women and men whose active participation in the program is dependent on securing reliable care for young children. A generous donation from the Berland Foundation has made this program possible, but we seek additional support to serve more participants.

Name a Seat. For a gift of $1,500, you may name a seat in IPAM's lecture hall. IPAM donors named 34 of the 75 eligible seats. A plaque appears on the back of the seat with the name of the donor or someone the donor chooses to honor.

Industrial Support for Research in Industrial Projects for Students (RIPS). This is a unique research experience for undergraduate students sponsored by industry. We offer RIPS in Los Angeles and Singapore. A graduate-level version of RIPS is in Berlin, Germany and Sendai, Japan. RIPS allow U.S. students to work side-by-side with students from another country while gaining industrial math research experience.

FRONTIERS SOCIETY MEMBERS 2018-2019

IPAM thanks everyone who joined the Frontiers Society, gave to the Director's Endowment Fund, and all others who donated to IPAM in the past year. Special thanks to those who made multi-year pledges!

CHAMPIONS ($1,000+)

Tanya Beder and Joseph H. Bretton

James C. Fraser and Diana K. Fraser

Virgnia D. Hales and Alfred W. Hales

Monique L. Miller and Scott Miller

Maria Peran McGee

Charles L. Schwennesen and Sandy Schwennesen

Ronald J. Stern and Sharon Stern

Leland Wilkinson and Marilyn Vogel

Anonymous Donor

VISIONARIES ($500–$999)

Robert S. Baker

Diana R. Gillooly and Burt Totaro

Dimitri Y. Shlyakhtenko and Olga V. Radko

INNOVATORS ($100–$499)

Kathryn G. Bartlett

Allen Clement and Joanie Clement

Karina L. Edmonds

Madison B. Gray and Kristen L. Gray

Eilish Hathaway and Daniel G. Hathaway

Vijay Pedapudi

Nancy A. Potok

Tatiana Toro and Daniel Pollack

Anonymous Donor

UPCOMING PROGRAMS

LONG PROGRAMS

Machine Learning for Physics and the Physics of Learning
September 4–December 8, 2019

High Dimensional Hamilton-Jacobi PDEs
March 9–June 12, 2020

Mathematical Challenges and Opportunities for Autonomous Vehicles
September 14–December 18, 2020

Tensor Methods and Emerging Applications to the Physical and Data Sciences
March 8–June 11, 2021

WORKSHOPS

Theory and Computation for 2D Materials
January 13–17, 2020

Emerging Opportunities for Mathematics in the Microbiome
January 23–24, 2020

Deep Learning and Medical Applications
January 27–31, 2020

Asymptotic Algebraic Combinatorics
February 3–7, 2020

Computational Psychiatry
February 18–21, 2020

Intersections between Control, Learning and Optimization
February 24–28, 2020

SUMMER RESEARCH PROGRAMS

Graduate Summer School: Mathematics of Topological Phases of Matter
June 22–26, 2020

Research in Industrial Projects for Students (RIPS) Programs

Undergraduate
- *Singapore, June 1–July 31, 2020*
- *Los Angeles, June 22–August 21, 2020*

Graduate
- *Sendai, June 15–August 7, 2020*
- *Berlin, June 22–August 14, 2020*

CALL FOR PROPOSALS

IPAM seeks proposals from the mathematical, statistical, and scientific communities for its long programs, winter workshops, summer schools, and exploratory workshops. For all proposals, please include women and members of underrepresented minorities as organizers, speakers, and participants. Proposals are reviewed by IPAM's Science Advisory Board (SAB) at its annual meeting in November. To receive fullest consideration, please send your program idea by October 1 to the IPAM Director at **director@ipam.ucla.edu**.

WINTER WORKSHOPS

Winter workshops are typically five days in length, with 20–25 presentations. The proposal should include a short description of the mathematical and scientific content, names of individuals to serve on the organizing committee, and names of individuals that you would like to invite as speakers or participants. The SAB will consider proposals for winter 2021 at its upcoming meeting. Proposals for workshops on multiscale physics will be considered for inclusion in a series of workshops made possible by an endowment from the Julian Schwinger Foundation for Physics Research.

EXPLORATORY WORKSHOPS

Exploratory Workshops address urgent problems that mathematics may help solve. They are two or three days long, and can be organized in less than a year. The proposal should follow the guidelines for winter workshops, above, and will be considered at any time.

LONG PROGRAMS

Long Programs generally have two complementary streams: one mathematical and one (or more) from other related scientific disciplines where there is the potential for a fruitful and exciting interaction. A long program opens with tutorials, followed by four one-week workshops and a culminating workshop.

The proposal should include a brief description of the topic, names of individuals to serve on the organizing committee, and a preliminary list of senior researchers and representatives of industry and government you would like to invite. A long program proposal template is available online. Proposals for academic year 2021–2022 will be reviewed at the next SAB meeting.

SUMMER SCHOOLS

Summer schools are one to three weeks in length and incorporate both tutorials (a series of 3–4 talks) and research talks illustrating applications. They are directed toward graduate students and postdocs. The requirements for summer school proposals are comparable to those for winter workshops.

Mark Your Calendars

January 27, 2020. Jill Mesirov (UC San Diego) will give two public lectures this week as part of the Green Family Lecture Series.

February 12, 2020. Application deadline for IPAM's undergraduate and graduate Research in Industrial Projects for Students (RIPS) Programs in Berlin, Los Angeles, Sendai, and Singapore.

March 22, 2020. Application deadline for IPAM's Graduate Summer School: Mathematics of Topological Phases of Matter.

May 4, 2020. Alessio Figalli (ETH Zurich) will give two public lectures this week as part of the Green Family Lecture Series.

For more information, go to **www.ipam.ucla.edu**.

Stay Connected

Inspiring the Next Generation of Latinx Mathematicians

(*continued from page 1*)

Her epiphany came when she was teaching a calculus course, in which approximately 240 students were enrolled in two class sessions. During the term, Toro noticed that a large number of Latinx students attended her lectures — but she saw few of them on the day of the final exam. When Toro asked one of the students what had happened to all of the Latinx students who were usually there, she learned that those students were actually enrolled in another class, but since all of the calculus professors were teaching from the same lesson plan, they had chosen to attend Toro's lectures.

Upon further investigation, Toro learned the reason. "These students said it was intimidating to go into a lecture with 240 kids where so few people looked like them, and that if it had not been for me and a TA who was Latinx, they would have crumbled on the exam," she says.

By that time, Toro had become more involved with the Institute for Pure and Applied Mathematics (IPAM). After participating in multiple workshops, in 2010 she accepted the invitation of then-director Russel Caflisch to join IPAM's Board of Trustees. In this position, which Toro has held for going on a decade, she is part of a group that meets annually to approve IPAM's budget and plan for the upcoming year, as well as regularly communicating with the director on the institute's direction. As she became more familiar with IPAM, Toro decided it would be the ideal setting for a conference showcasing the achievements of Latinx in the mathematical sciences.

She approached Caflisch with her idea, and the result was the first of what have now been two Latinx in the Mathematical Sciences (LatMath) conferences, held in 2015 and 2018, with Toro serving as the lead organizer. The three-day IPAM-hosted conference — most recently sponsored by the Mathematical Sciences Institutes Diversity Initiative, with funding from the National Science Foundation — aims to highlight the research of Latinx who are at the forefront of their fields; promote the advancement of Latinx currently in the discipline; and build a community around shared academic interests.

"My idea was to bring in lots of young Latinx, particularly those who grew up in the U.S., and show them that there are people like them who are successful in mathematics or the mathematical sciences, and that they too can succeed," Toro explains. The conference has included both undergraduate and graduate students, as well as drawing from high schools in the region. The conference has been so successful that it will continue on an ongoing basis, with the third in the LatMath series — under the leadership of Anthony Varilly-Alvarado (Rice) — currently in its early planning stages slated for the spring of 2021.

"If this helps even 10-15 percent of the attendees decide to go all the way to their PhD, become excellent scientists and set an example for the community, it's a great investment," Toro says. "People who come from different cultures tend to think about problems in different ways, so diversifying mathematics brings in different points of view that can enrich the field for everyone. And on a personal level, when you become more senior, the theorems are certainly important, but being able to make even a small impact in changing the face of the profession by inspiring these young people is very fulfilling." ■

Institute for Pure and Applied Mathematics

a National Science Foundation Math Institute
at the University of California, Los Angeles

405 Hilgard Avenue
Box 957121, 460 Portola Plaza
Los Angeles, CA 90095
p: 310-825-4755
f: 310-825-4756
www.ipam.ucla.edu

math changes everything.

MATHEMATICAL CHALLENGES AND OPPORTUNITIES FOR AUTONOMOUS VEHICLES (SEPT 14—DEC 18, 2020)

In fall 2019, IPAM will host a long program on mathematical challenges for autonomous vehicles (AVs). AV research and development has achieved a similar status in terms of money invested, societal excitement, and media coverage as space travel and exploration. At the same time, AV research is not rocket science — it is more complicated: while in itself, an AV is no more complex than a spacecraft, it must reliably interact and communicate with many other agents, particularly humans both inside and outside of the vehicle, much of it in a decentralized fashion. Hence, AVs, and their impact on us humans and our transportation systems, incur some of the most complicated science and engineering challenges that we will face in the near future. There is also disconnect across the various research communities: professional product development is highly opaque, and public expectations and media communications are frequently inaccurate or exaggerated.

This long program aims to address these problems by connecting research communities, bridging gaps between theory and practice, exposing software experts to hardware and vice versa, and bringing mathematicians, other scientists, and engineers together to shape the research and development agenda on AVs, both in terms of individual and holistic components.

Financial support is available to attend and participate for extended periods up to the entire length of the program. To learn more and apply for consideration, visit: **www.ipam.ucla.edu/av2020**. ■